LETTERS TO THE EDITOR.

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On the Theory of Magneto-ionisation.

I BEG permission to make a few remarks on the note in NATURE of September 13, p. 32, in which one of my latest papers is criticised, the one in which I gave, I think, a direct proof of magneto-ionisation.

In the experiment which the writer of the note takes into consideration the intensity of the current in the air ionised by a beam of X-rays between two parallel metal plates is measured. I find that a magnetic field directed perpendicularly to the electric field, and the intensity of which is below a certain value, causes an increase of current, although the deviations of the ions and electrons tend to produce a decrease. This effect is uncertain in the case of small potential differences, but it becomes considerable when ionisation by collision begins.

The writer of the note remarked that "when a magnetic field of 430 gauss is superimposed, there is found a current decrease . . ." Now, the numerical table to which he alludes is not the only one given in the paper, and it shows such a decrease (which is very small) in one case only, which may be considered as accounted for by experimental error, since nothing of the kind is found in the other numerical tables. That, of course, leads one to suppose that the writer is not fully acquainted with certain parts of my work, and what he says farther on seems to confirm this supposition: "In the opinion of the writer of this note Prof. Righi's interpretation of his results is by no means the only one which is possible, and though his ingenious experiments are of great interest, his theory will need further support before it obtains general acceptance. In particular, it will be necessary to show that the increase of current is not caused by the oblique, and therefore longer, paths of the ions under the joint actions of the two fields."

The writer then offers a new theory, or, more exactly, he states a general idea, which he seems to consider to be preferable to my theory. But this idea cannot be admitted, as I now propose to show.

Apart from the fact that the writer appears to believe that the effect of the magnetic field is simply the obliquity of the trajectory of the ions, whereas these trajectories become certain well-known curves (which may be deduced from the formulæ given in the third paragraph of the note added to my paper), I at once make the fundamental objection that it is not sufficient to increase the distance travelled over by an ion in order that the latter may become capable of ionising a larger number of atoms. In fact, as in ionisation by collision an ion loses a part of its kinetic energy, it would be necessary to prove that the magnetic field causes the said energy to increase. Now this is not at all the case, since by means of the formulæ of the movement of an ion in an electric and magnetic field it is demonstrated that when the ion traverses a plane perpendicular to the electric field it possesses exactly the same velocity, be the magnetic field existent or not.

It may be added that when the magnetic field does exist, the speed of the ion may increase only to a maximum value, after which it decreases again, the ion retroceding in respect of the lines of electric force, while if the magnetic field does not exist, the velocity may increase without limit, provided it be not stopped by the electrode which attracts it or by collision with molecules. All this is clearly understood when one knows that, apart from the velocity parallel to the magnetic force, which remains constant, the trajectory of the ion is nothing but the curve described by a point travelling at a constant speed over a circumference, while the latter is itself travelling uniformly in a straight line in a direction perpendicular to the two fields.

Finally, I wish to point out that, even if the idea expressed by the writer of the note did not lack a basis, my theory could not easily be rejected. It is, in fact, but a direct consequence of the conceptions already accepted by most physicists, nor does it need the addition of any subsidiary hypothesis.

As a matter of fact, it being admitted that atoms have satellite electrons, they must tend to orient themselves in the magnetic field as if the orbits of such electrons were closed electric currents. Now the sense of this orientation is such that the force due to the field, and acting on the electrons, is directed towards the outside of the orbits, which causes a decrease of the energy required to detach them from the rest of the atoms.

It is this facility of ionisation produced by the magnetic field that constitutes "magneto-ionisation."

AUGUSTO RIGHI.

Bologna (Italy), September 27.

I AM sorry if, owing perhaps to the brevity of my note, I have led Prof. Righi to think that, in my opinion, his theory of magneto-ionisation can be "easily rejected." Nothing was further from my intention. I believe I have read all Prof. Righi's papers on the subject as they have appeared, and have repeated some of his experiments. The impression they have left on my mind is that, although Prof. Righi's theory gives a plausible explanation of the complex phenomena investigated, yet it is not the only one possible, and further work is necessary before a final conclusion can be reached. I did not express a *preference* for another theory. I merely suggested objections that would have to be met before the theory under discussion could be unhesitatingly accepted. The question as to whether I have given a fair account of the numerical results must be left to the decision of the readers of the memoir.

THE WRITER OF THE NOTE.

The Introduction of the Word "Magneton."

THE word "magneton" is now so frequently used that it has seemed worth while to me to seek to learn to whom is due this addition to the vocabulary of physics.

So far as I can find, Dr. L. A. Bauer was the first to employ the word. In the weekly journal, *Science* (June 10, 1910, vol. xxxi., p. 920), is a report of a meeting of the Philosophical Society of Washington, D.C., held on May 7, 1910. There is included an abstract of a paper by Dr. Bauer entitled "Is there an Emanation from a Magnetised Substance?" in which the following occurs:—"The corpuscles in magnetism might be atomic systems in which the electron is revolving about an inner nucleus consisting, for example, of a positive ion, such as assumed by Righi for the formation of his so-called 'magnetic rays.' . . . Since the system creates an atomic magnetic field the axis of which passes through the centre of rotation of the electron and perpendicular to the plane of rotation, the speaker suggested calling such systems 'magnetons.'"

In a letter to me Dr. Bauer says:—"The term was used not only in my paper before the Philosophical Society of Washington on May 7, 1910, but also in my

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lectures on terrestrial magnetism at the Johns Hopkins University a month or so previously."

Because Prof. R. Gans had used the same word quite early, I wrote to him to ask his aid in locating its earliest occurrence. He replied to me from Argentina, saying:—"Auch mich interessirt es zu wissen wer das Wort 'Magneton' zum ersten Male gebraucht hat. Ich selbst habe wohl das Wort zuerst in der von Ihnen erwaehnten Arbeit in den *Göttinger Nachrichten,* 1910, verwendet. Die Arbeit von Bauer, den Sie zitieren, kenne ich nicht." The article referred to by Prof. Gans in *Göttinger Nachrichten,* 1910, p. 200, was presented at the session of May 28, 1910, by C. Runge. In the course of the discussion we find this: "Die lage jedes Molekularmagneten, oder wie wir kuerzer sagen wollen, jeden Magnetons. . . ."

Since Prof. Pierre Weiss conferred on the word under investigation the quantitative meaning which it seems likely to retain, I turned to him also for assistance, He wrote me in reply:—"J'ai imaginé le nom de 'magnéton' à la suite de mes recherches expérimentales. L'analogie avec l'électron s'imposait. J'ai eu connaissance plus tard que M. Gans avait fait usage antérieurement du même terme dans un sens différent. Il me semble que, dans ce sens, l'expression de molécule magnétique convient tout aussi bien. Je n'avais pas connaissance jusqu'à present de l'emploi fait de ce terme par M. L. A. Bauer et je vous remercie du renseignement."

In the *Comptes rendus* of the Paris Academy of Sciences, vol. clii., p. 189, session of January 23, 1911, occurs the first use of the word by the Zurich physicist in an article called "Sur la rationalité des rapports des moments magnétiques des atomes et un nouveau constituant universel de la matière." Near the close we come upon the following:—"Le nombre d'atomes dans l'atome-gramme est $N=70\times10^{22}$ (Perrin). Le quotient m; $N=15{\cdot}94\times10^{-22}$ est le moment de l'aimant élémentaire lui-même, correspondant à la partie aliquote des moments des atomes-grammes. Je l'appelerai magnéton. . . . Le magnéton est donc un constituant universel de la matière."

It is surely interesting to note that three physicists in as many different countries independently introduced the word within a year. Priority appears to belong to Dr. Bauer.

As some uncertainty can be observed in the pronunciation of "magneton," I appealed to its sponsor, Dr. Bauer, for a decision. He replied: "I hesitate greatly desiring to appear competent to pass on the official pronunciation of the word 'magneton.' I prefer the accent on the second syllable, and giving the sound of *e* as in 'thee,' thus—magneeton. Still, I should not quarrel with anyone who wishes to put the accent on the first syllable and pronounce the *e* as in 'met.' Usage alone will decide." GEORGE F. STRADLING.

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An Optical Phenomenon.

A DESCRIPTION of the phenomenon mentioned by Capt. Cave in NATURE of October 18 will also be found in NATURE, vol. lxx., p. 107 (1904), and vol. lxxviii., pp. 255, 277, and 305 (1908). J. W. GILTAY.

Delft, November 9.

THE NICKEL INDUSTRY.

THE complete report of the Royal Ontario Nickel Commission, of which a summary was published in March last, has recently been received in this country. It is a document of absorbing interest and exceptional importance. The commission was appointed on September 9, 1915, and asked to inquire into, and investigate and report upon, the resources, industries, and capacities, both present and future, of the Province of Ontario in connection with nickel and its ores. Its reference also included an inquiry into the system of taxation by the province of its mines, minerals, and mineral industries. There were four commissioners, Messrs. Holloway, Miller, Young, and Gibson, representing metallurgy, geology, law, and administration respectively. They set to work at once and completed their labours in eighteen months—a remarkably short time considering what they did. Their report contains nearly 600 pages, and the appendix more than 200. It is a model of lucidity of exposition, and displays such a complete grasp of the subject in all its bearings and details, and such shrewdness of judgment in regard to its recommendations, that it will certainly rank as the most authoritative monograph on the nickel industry that has ever been published. The commissioners have rendered to Canada a service of remarkable value.

It appears that, so recently as 1900, as much as 65 per cent. of the world's market was supplied by nickel made from the New Caledonia ores, the balance being furnished by Canadian ores. New Caledonia, although discovered and named by Capt. Cook in 1774, was not claimed by any European country until 1854. In that year it is said that a French and a British frigate sailed simultaneously from Sydney (Australia) to take possession of it. The former was the first to find a way through the barrier reef and thus secured the island for France. The commissioners comment on the striking fact that "two countries so widely separated as are Ontario and New Caledonia, not only by distance, but in almost every other way, should alone be rivals, not merely in the production of nickel, but in that of cobalt as well."

For many years nickel from New Caledonia had an established world market. It was included in all British Government specifications where nickel was required. When the Mond Nickel Co., working on Sudbury ores, entered the field, it found an immensely strong prejudice both in Government departments and the trade against them, which was overcome only after elaborate and expensive trials and tests. Moreover, the New Caledonia nickel had for many years a tied market among the principal consumers in Europe, owing to the close business connections of the leading French producer—Le Nickel—with the great armament firms. This company has the financial backing of the Rothschilds and is the chief rival of the Canadian companies.

Since 1900 Ontario has forged ahead with its production. The world's output has increased sixfold since that time, and of this Ontario now furnishes about 80 per cent. The main factor in this change is the great difference in the size of the ore-bodies in the two countries. Whereas those of New Caledonia are reckoned in at most hundreds of thousands of tons, the Sudbury (Ontario) deposits are measured in millions. In spite of its apparently favourable position, how-

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